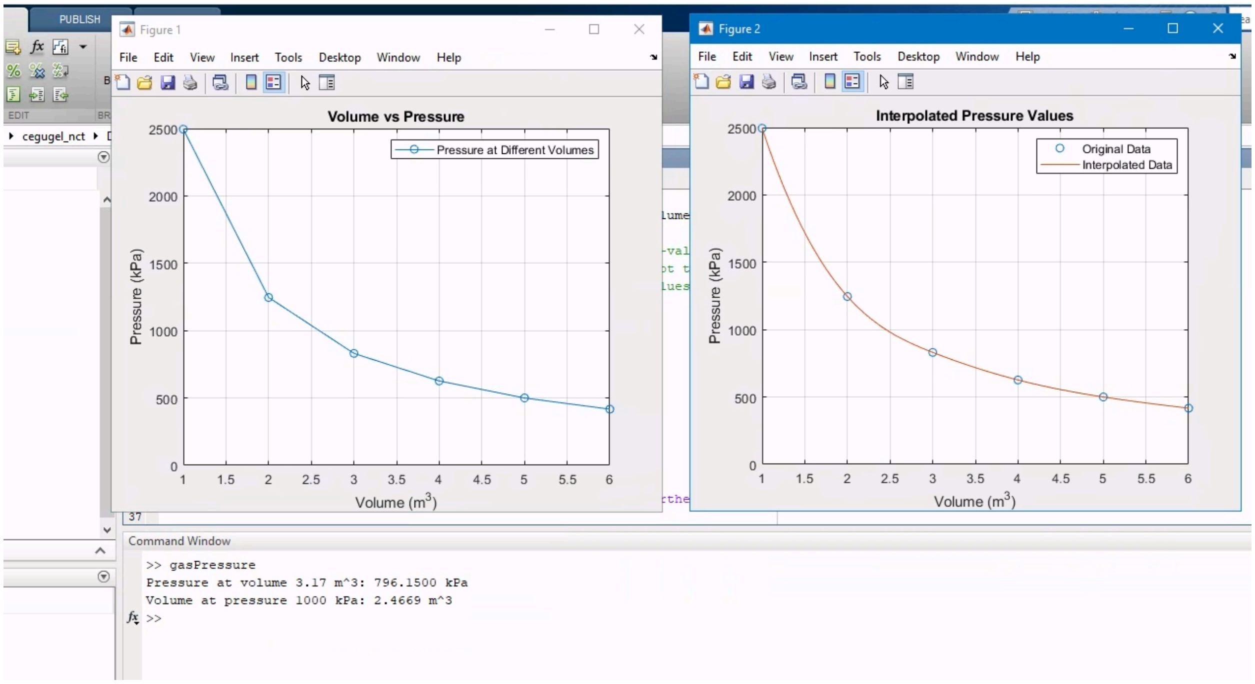
Question 1:

```
% Constants
volume = [1, 2, 3, 4, 5, 6];
pressure = [2495, 1246, 831, 626, 500, 417];

% (a) Plot the data on a x-y plot (volume-pressure) and label it properly.
figure;
plot(volume, pressure, 'o-');
xlabel('Volume (m^3)');
ylabel('Pressure (kPa)');
title('Volume vs Pressure');
hold on; grid on;
legend('Pressure at Different Volumes');

% (b) Use linear interpolation to estimate the pressure when the volume is 3.17 m^3
interp_pressure = interp1(volume, pressure, 3.17, 'linear');
fprintf('Pressure at volume 3.17 m^3: %.4f kPa\n', interp_pressure);

% (c) Use cubic spline interpolation to estimate the volume if the pressure is at 1000 kPa.
interp_volume = interp1(pressure, volume, 1000, 'spline');
fprintf('Volume at pressure 1000 kPa: %.4f m^3\n', interp_volume);

% (d) Use cubic spline interpolation to approximate pressure-values for volume-values evenly
% spaced between 1 and 6 at an interval of 0.05. And then Plot the original data on an x-y plot
% using data points only (no connected line) with the new values calculated (as a line).

volumes_interp = 1:0.05:6;
pressures_interp = spline(volume, pressure, volumes_interp);

figure;
plot(volume, pressure, 'o');
hold on; grid on;
plot(volumes_interp, pressures_interp, '-');
xlabel('Volume (m^3)');
ylabel('Pressure (kPa)');
title('Interpolated Pressure Values');
legend('Original Data', 'Interpolated Data', 'Location', 'northeast');
```



Question 2:

```
%(a) Define a x vector from -3 to 3 (1 as increment), and use it together with diff command to
% approximate the derivative of y with respect to x

x = -3:1:3;
y = 4*x.^3 - 5*x.^2 + 6;
dy_dx_diff = diff(y) ./ diff(x);
dy_dx_diff = [dy_dx_diff, NaN]; % add NaN to make it same length as x

% (b)Calculate the derivative analytically.
dy_dx_analytical = 12*x.^2 - 10*x;

% (c) Calculate the percentage error between approximation and analytical values.
percentage_error = abs((dy_dx_diff - dy_dx_analytical) ./ dy_dx_diff) * 100;

% (d) Print out a table which shows the vector x, approximated values, analytical results, and
the percentage error
fprintf('x\tdiff Difference\tAnalytical Solution\tPercent Error\n');
for i = 1:length(x)
   fprintf('%d\t%.3f\t\t\t%.3f\t\t\t\t%.3f%%\n', x(i), dy_dx_diff(i), dy_dx_analytical(i),
percentage_error(i));
end
```

Command Window

```
>> derivCalc
x   diff Difference Analytical Solution Percent Error
-3  101.000         138.000             36.634%
-2  43.000          68.000              58.140%
-1  9.000           22.000              144.444%
0   -1.000          0.000               100.000%
1   13.000          2.000               84.615%
2   51.000          28.000              45.098%
3   NaN         78.000              NaN%
>>
```